



NERSC

**National Energy Research
Scientific Computing Center**

Richard Gerber

NERSC Senior Science Advisor
High Performance Computing Department Head

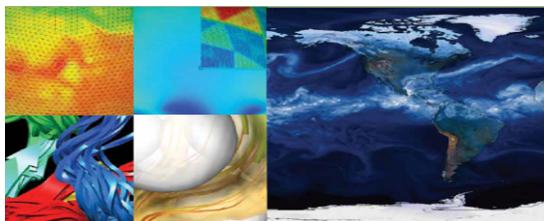
NERSC: the Mission HPC Facility for DOE Office of Science Research



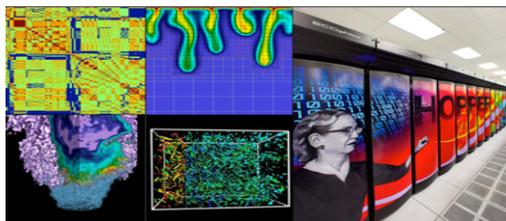
U.S. DEPARTMENT OF
ENERGY

Office of
Science

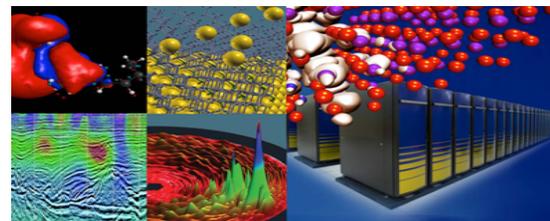
Largest funder of physical
science research in the U.S.



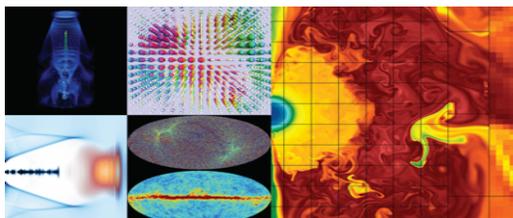
Bio Energy, Environment



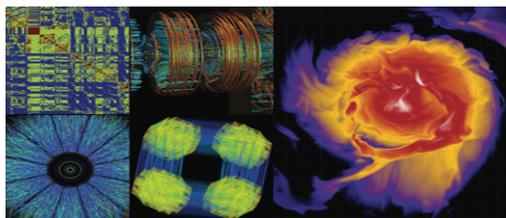
Computing



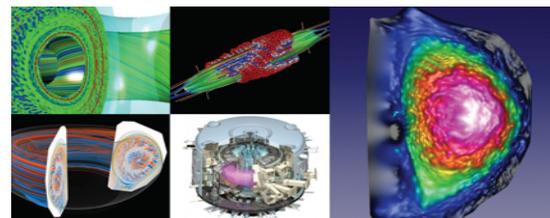
Materials, Chemistry, Geophysics



Particle Physics, Astrophysics



Nuclear Physics



Fusion Energy, Plasma Physics

6,000 users, 700 projects, 700 codes, 48 states, 40 countries, universities & national labs



U.S. DEPARTMENT OF
ENERGY

Office of
Science

Focus on Science



NERSC supports the broad mission needs of the six DOE Office of Science program offices

6,000 users and 750 projects

Supercomputing and data users

NERSC science engagement team provides outreach and POCs

2,078 refereed publications in 2015

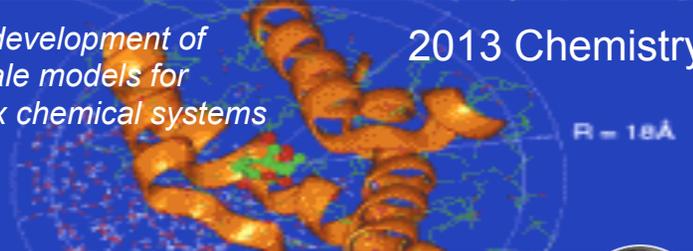


Nobel-Prize Winning Users



for the development of multiscale models for complex chemical systems

2013 Chemistry



Martin Karplus



for the discovery of the accelerating expansion of the Universe through observations of distant supernovae

2011 Physics

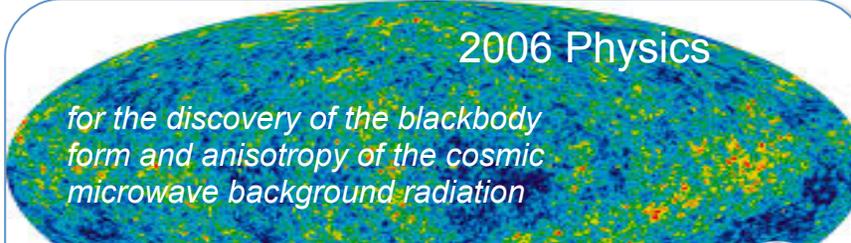


Saul Perlmutter



for the discovery of the blackbody form and anisotropy of the cosmic microwave background radiation

2006 Physics

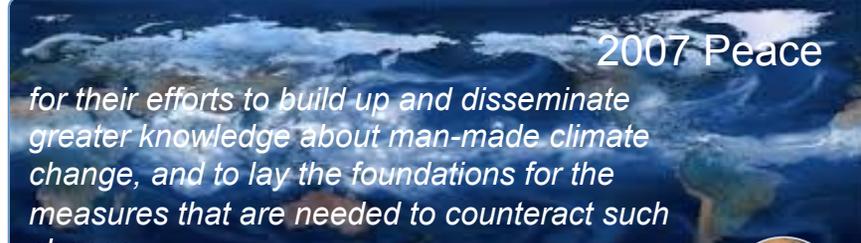


George Smoot



for their efforts to build up and disseminate greater knowledge about man-made climate change, and to lay the foundations for the measures that are needed to counteract such change

2007 Peace



Warren Washington



Nobel Prize in Physics 2015



Scientific Achievement

The discovery that neutrinos have mass and oscillate between different types

Significance and Impact

The discrepancy between predicted and observed solar neutrinos was a mystery for decades. This discovery overturned the Standard Model interpretation of neutrinos as massless particles and resolved the “solar neutrino problem”

Research Details

The Sudbury Neutrino Observatory (SNO) detected all three types (flavors) of neutrinos and showed that when all three were considered, the total flux was in line with predictions. This, together with results from the Super Kamiokande experiment, was proof that neutrinos were oscillating between flavors and therefore had mass



A SNO construction photo shows the spherical vessel that would later be filled with water.

Calculations performed on PDSF & data stored on HPSS played a significant role in the SNO analysis. The SNO team presented an autographed copy of the seminal *Physical Review Letters* article to NERSC staff.

Q. R. Ahmad et al. (SNO Collaboration). *Phys. Rev. Lett.* 87, 071301 (2001)

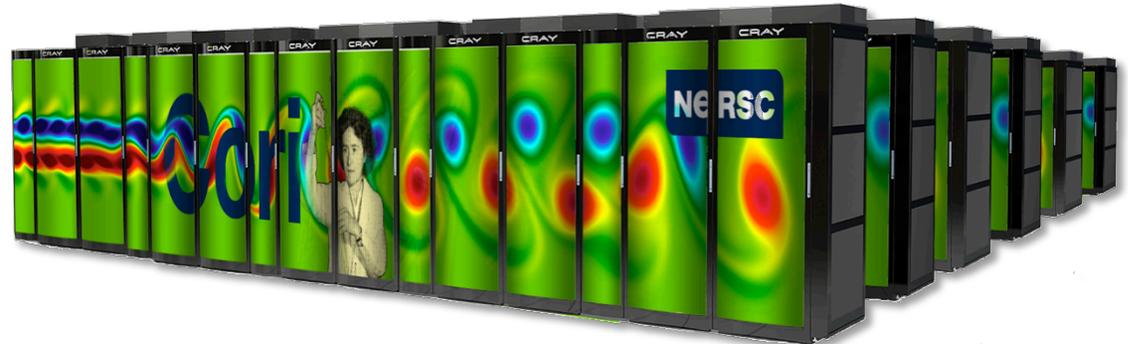
Nobel Recipients: Arthur B. McDonald, Queen’s University (SNO)
Takaaki Kajita, Tokyo University (Super Kamiokande)

Production High Performance Computing Systems



Cori

9,300 Intel Xeon Phi "KNL" manycore nodes
2,000 Intel Xeon "Haswell" nodes
700,000 processor cores, 1.2 PB memory
Cray XC40 / Aries Dragonfly interconnect
30 PB Lustre Cray Sonexion scratch FS
1.5 PB Burst Buffer



#5 on list of Top 500 supercomputers in the world



Edison

5,560 Ivy Bridge Nodes / 24 cores/node
133 K cores, 64 GB memory/node
Cray XC30 / Aries Dragonfly interconnect
6 PB Lustre Cray Sonexion scratch FS

Cori Characteristics



Cray XC40 system with 9,300 Intel Knights Landing compute nodes

68 cores / 96 GB DRAM / 16 GB HBM

Support the entire Office of Science research community

Begin to transition workload to energy efficient architectures

Data Intensive Science Support

10 Haswell processor cabinets (Phase 1)

NVRAM Burst Buffer 1.5 PB, 1.5 TB/sec

30 PB of disk, >700 GB/sec I/O bandwidth

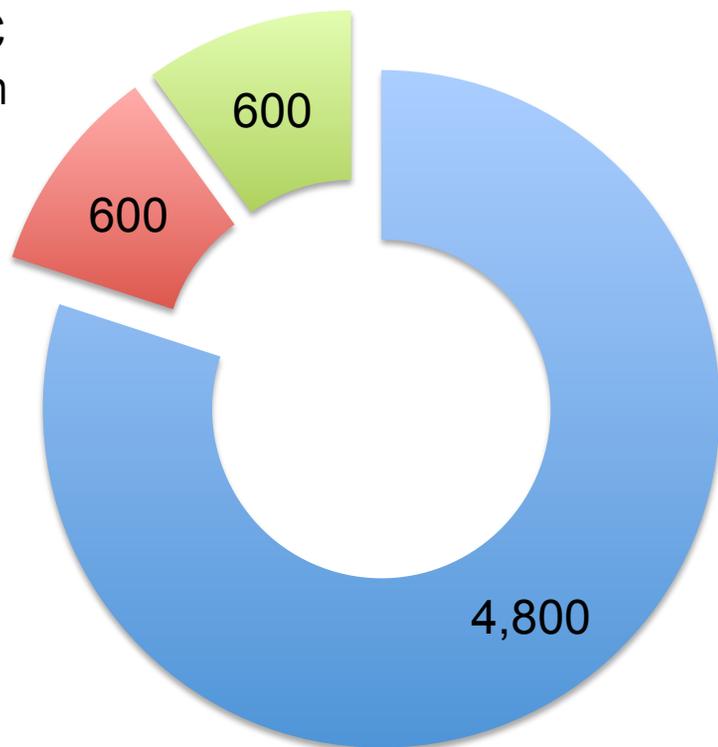
Integrated with Cori Haswell nodes on Aries network for data / simulation / analysis on one system



Allocation of Computing Time 2017

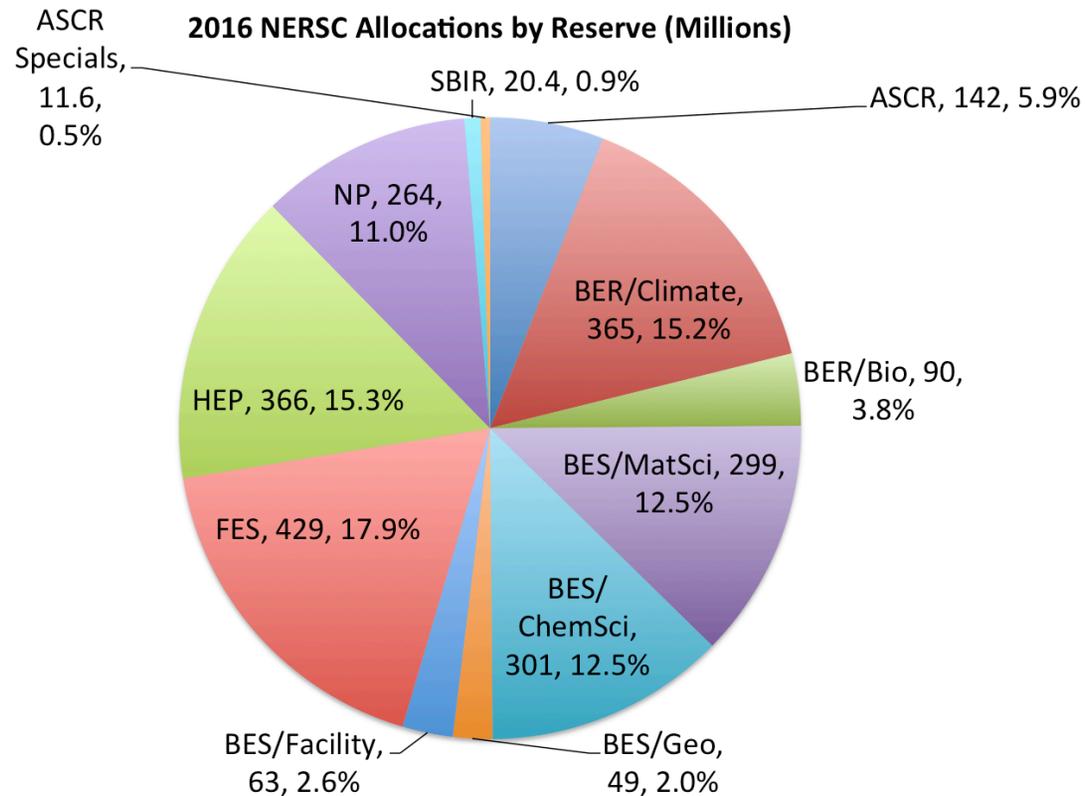


NERSC
hours in
millions

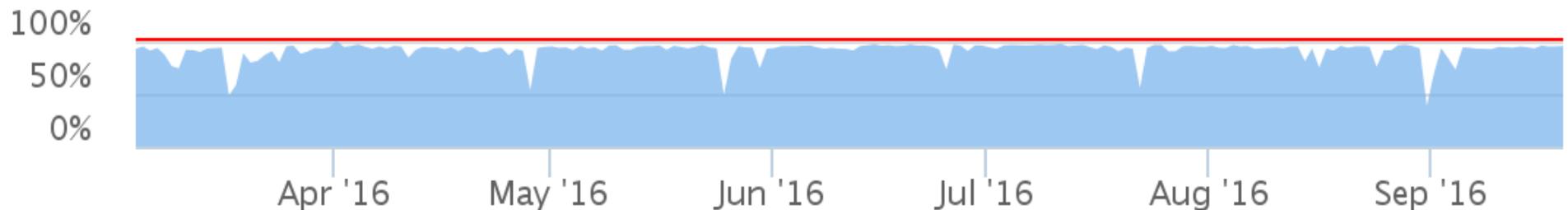


- **DOE Mission Science 80%**
Distributed by DOE Office of Science program managers
- **ALCC 10%**
Competitive awards run by DOE Advanced Scientific Computing Research Office
- **Directors Discretionary 10%**
Strategic awards from NERSC

Initial Allocation Distribution Among Offices for 2016



NERSC has ~100% utilization



NERSC has a commitment to provide HPC to a very active scientific community, for which access to time limits their research.

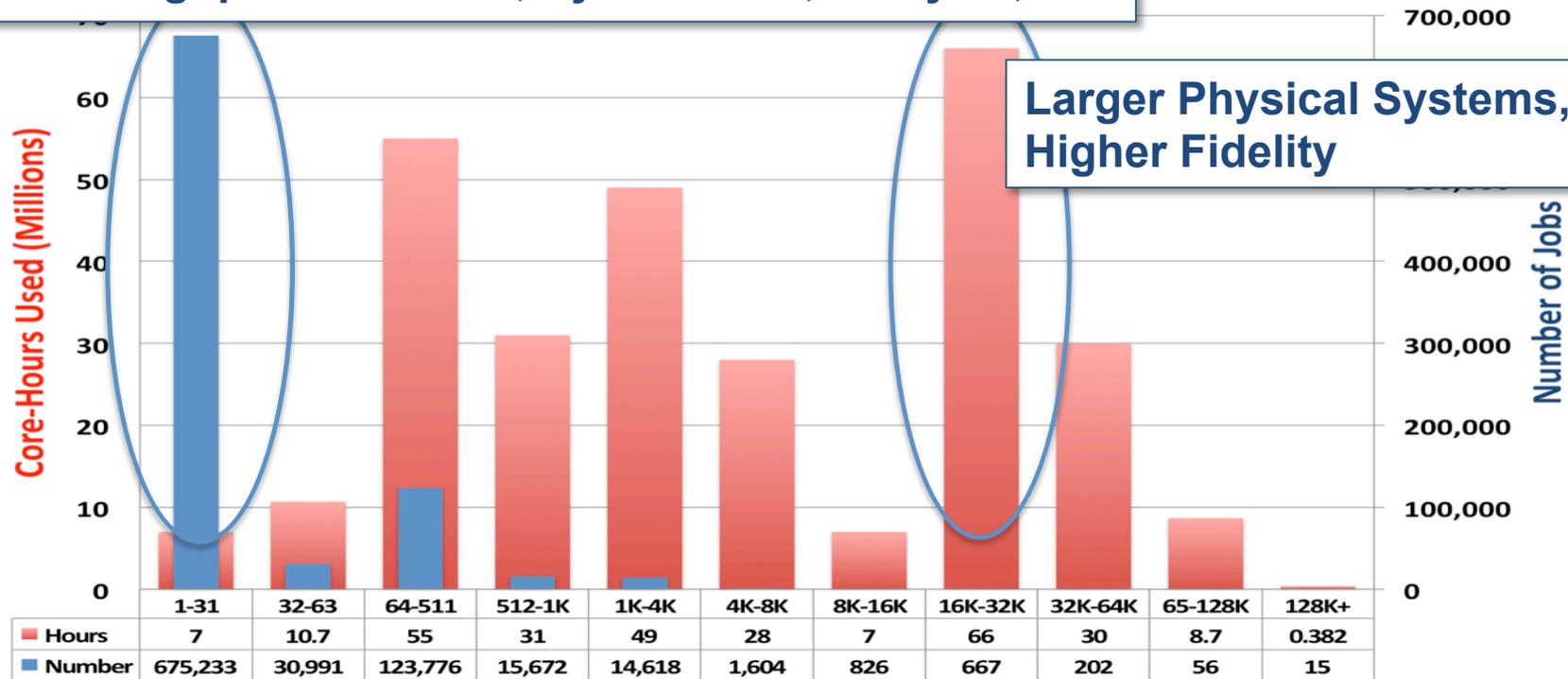
NERSC runs 24x7x365.25 at full capacity.

It's important for projects to get support and an allocation from a DOE program manager or through ALCC so they can get access to resources.

NERSC Supports Jobs of all Kinds and Sizes



High Throughput: Statistics, Systematics, Analysis, UQ

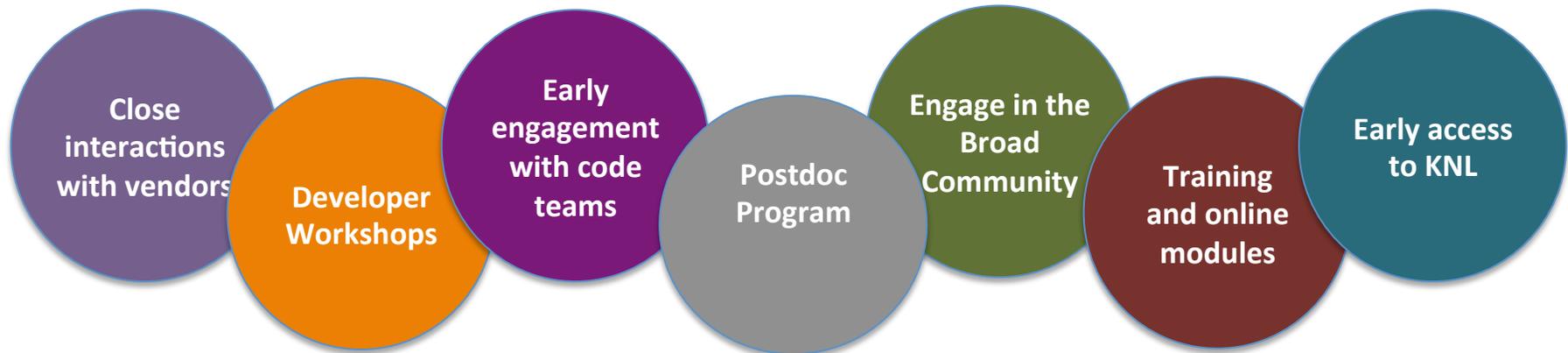


NERSC Exascale Scientific Application Program (NESAP)



Goal: Prepare DOE Office of Science users for Cori's manycore CPUs
Partner closely with ~20 application teams and apply lessons learned to broad NERSC user community

NESAP activities include:



NERSC NESAP Team



Katie Antypas



Nick Wright



Richard Gerber



Brian Austin



Zhengji Zhao



Helen He



Stephen Leak



Woo-Sun Yang



Rebecca Hartman-Baker



Doug Doerfler



Jack Deslippe



Brandon Cook



Thorsten Kurth



Brian Friesen

NESAP Postdocs



Taylor Barnes
Quantum **ESPRESSO**



Zahra
Ronaghi



Andrey Ovsyannikov
Chombo-Crunch



Mathieu Lobet
WARP

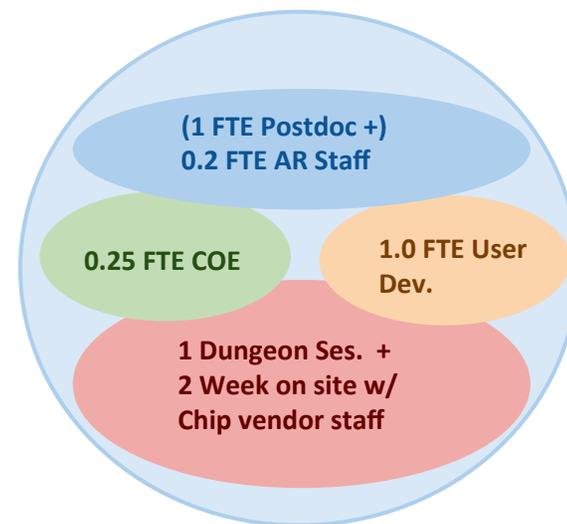


Tuomas Koskela
XGC1

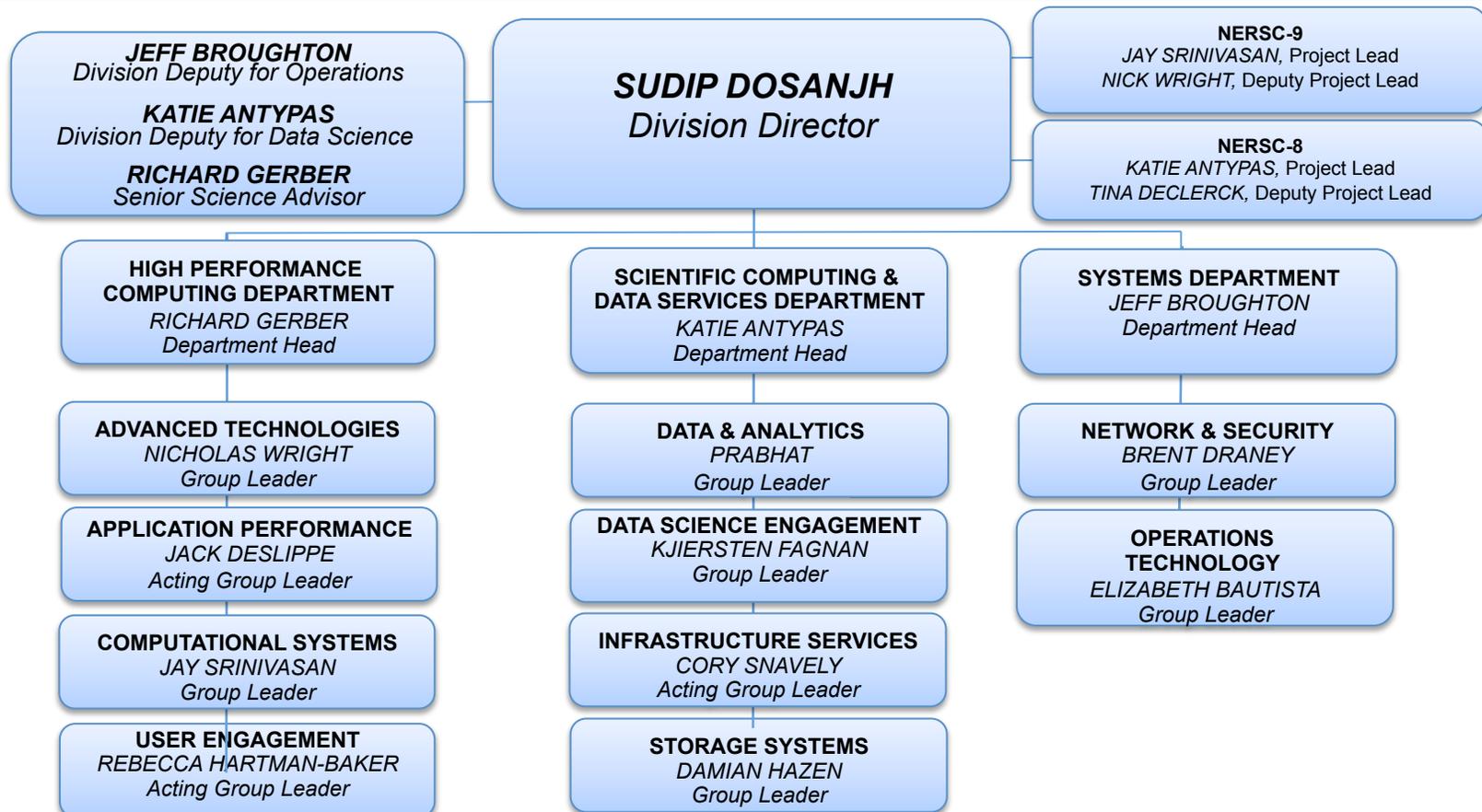


Tareq Malas
EMGeo

Target Application Team Concept



National Energy Research Scientific Computing Center



NERSC at a Glance

A U.S. Department of Energy Office of Science User Facility
Provides High Performance Computing and Data Systems and Services
Unclassified Basic and Applied Research in Energy-Related Fields
6,000 users, 700 different scientific projects
Located at Lawrence Berkeley National Lab, Berkeley, CA
Permanent Staff of about 70

